Risk-sharing in the context of fishery mutual insurance

Marine Policy xxx (xxxx) xxx

Contents lists available at ScienceDirect

Marine Policy

journal homepage: http://www.elsevier.com/locate/marpol

Risk-sharing in the context of fishery mutual insurance: Learning from China

Minzhen Jiang [a], Michael Faure [b,*]

[a] Faculty of Law, Maastricht University, Netherlands
[b] Maastricht University and Professor of Private Law and Economics at the Institute of Law and Economics at Erasmus University Rotterdam, Netherlands

ARTICLE INFO

Keywords:
Fishery mutual insurance (FMI)
Risk-sharing
Government subsidy

ABSTRACT

Although China remains the largest producer in the fishery industry worldwide, it faces substantial personal injuries and economic losses created by this sector. Considering insurance is a mechanism that potentially could deal with fishery-related losses, China set up private fishery insurance in the 1980s, but it largely failed in the 1990s. Over the past twenty-six years, China has developed an alternative financial mechanism, called fishery mutual insurance (FMI) to spread out risks, among which a large number of members are individual fishermen and owners of small-scale fishing vessels. Since 2008, there has been increasing financial support for FMI provided by the government. Guided by non-profitable FMI associations, FMI becomes a model of sharing risks among fishermen that create risks, which is substantially more like a risk-sharing agreement than a form of insurance. The paper analyzes the potential of this risk-sharing agreement in minimizing the total social costs of fishery-related activities in comparison to private insurance. Special interest is also given to identifying the problems that will constrain the promotion of FMI in the context of China.

1. Introduction

China is the world's top producer of both wild and farmed fish, and since 2002 has also been the largest exporter of fish and fish products.[1] The most recent estimates from the *Food and Agriculture Organization of the United Nations* (FAO) indicate that approximately 14,6 million people in China were active as fishermen or fish farmers in 2016, accounting for 25% across the world[2] Up to 2018, the total value of production in the fishery was CNY 1281 billion, holding 1,42% of the nation's GDP.[3]

The fishery sector, including fishing and aquaculture, is facing higher risks and more severe natural disasters than other industries.[4] Comparing fatality statistics in the fishing industry with those for other occupational categories reveals that fishing is one of the most dangerous occupations.[5] It was reported that fishermen and related fishing workers had the highest fatal injury rate of any occupation since 2005 in the world.[6] Between 1994 and 2011, approximately 120/100.000 people

* Corresponding author.
E-mail addresses: minzhen.jiang@maastrichtuniversity.nl (M. Jiang), michael.faure@maastrichtuniversity.nl (M. Faure).

[1] Food and Agriculture Organization of the United Nations (FAO), The state of the world fisheries and aquaculture in 2018, available at http://www.fao.org/3/i9540en/i9540en.pdf (last accessed on December 2, 2019). p.30.

[2] *Ibid.*

[3] In 2018, the total gross domestic production (GDP) in China was CNY 90.03 billion, among which the fishery industry contributed CNY 1281 billion. See National Bureau of Statistics of PRC, National economy and society developed statistical bulletin in 2018, available at http://www.stats.gov.cn/tjsj/zxfb/201902/t20190228_1651265.html (last accessed on December 2, 2019); also see the Ministry of Agriculture of the PRC, The statistical report of national fishery in China in 2018, available at http://www.cappma.org/view.php?id=3047 (last accessed on December 2, 2019).

[4] Sun, X.; Zhong, F (2008). The welfare economic analysis of crop insurance subsidy (in Chinese). *Agricultural Economics*, vol. 2, pp. 1–11.

[5] Food and Agriculture Organization of the United Nations (FAO), a report on the fatalities in fisheries, available at http://www.fao.org/3/x9656e/X9656E.htm (last accessed on December 12, 2019).

[6] Janocha J. (2012). Facts of the catch: occupational injuries, illnesses, and fatalities to fishing workers, 2003–2009, Beyond the Numbers: Workplace Injuries, Vol. 1, No. 9 (U S. Bureau of Labor Statistics), available at https://www.bls.gov/opub/btn/volume-1/facts-of-the-catch-occupational-injuries-illnesses-and-fatalities-to-fishing-workers-2003-2009.htm (last accessed on December 2, 2019).

https://doi.org/10.1016/j.marpol.2020.104191
Received 29 April 2020; Received in revised form 27 July 2020; Accepted 17 August 2020
0308-597X/

died and 832/100.000 people were injured per year according to the claim settlement record of the China Fishery Mutual Insurance Association (CFMI), the rate of which (fatality and injury) was much higher than that of people engaged in other industries in China.[7] Some scholars argue that the actual losses can be more extensive than the official version.[8]

The chart below shows the death toll and the amount of direct economic losses in the fishery sector from 2010 to 2018.

Year	Fatalities	Direct economic losses (billion, CNY)
2010	242	20.5
2011	142	25.8
2012	164	23.7
2013	165	25.7
2014	88	21.2
2015	33	20.0
2016	165	28.7
2017	58	17.3
2018	43	15.7

Source: the Annual Fishery Statistics Report of China from 2010-2018[9]

Fishery is generally seen as a high-risk industry, as it can lead to personal injuries, economic losses, and environmental damage. On the one hand, Chinese coastal areas go through a number of meteorological disasters all the year round, while both fishery and aquaculture are the sectors that are highly dependent on natural conditions. That is, there is a possibility of extreme natural disasters that results in considerable damage to fishery activities. On the other hand, although China remains the most prominent fish producer in the world, it is a developing country with a large percentage of individual fishermen and owners of medium- and small-size fishing vessels. Their limited financial conditions are not sufficient to technically handle huge fishery risks. Therefore, the problem of tackling fishery risks is a significant concern in the context of the fishery industry in China.

Insurance has been widely used in agriculture as a means to mitigate financial risks and to reduce the negative impacts of natural catastrophes. However, an attempt to launch commercial fishery insurance in China proved to fail in the late 1980s. During the following two decades, China has established a financial mechanism called 'fishery mutual insurance' (FMI),: a risk-sharing pool financed by individual fishermen and fishery companies to share risks. The question arises why private insurance failed and why FMI replaced it. This article aims at sketching the working of FMI in China in the light of the theoretical literature concerning the differences between insurance and risk-sharing.

The paper is structured as follows: after this introduction, section 2 describes the failure of private insurance in the past as well as the attempt to set up mutual insurance since the 1990s. Based on this descriptive analysis, section 3 analyzes FMI from the perspective of law and economics. The core question in that analysis focuses on why fishery insurance failed and what are the conditions which made risk-sharing via FMI succeed. Section 4 concludes the paper.

2. The development of FMI in China

2.1. Private fishery insurance - a brief history

A program of fishery insurance in China was initiated in 1982 by the People's Insurance Company of China (PICC)[10] as part of the company's agriculture services. The PICC initially monopolized the market. One year later, the PICC, together with the Ministry of Agriculture (MOA), issued two normative documents as guidance concerning fishery insurance[11] to welcome other insurance companies to enter the market.[12] However, by 1992, the fishery sector proved itself to be an expensive class of insurance for both insurers and insured in China: the high risks in the fishery sector led to a high premium, yet a high premium caused fewer fishermen to purchase this insurance, driving insurance companies to charge an even higher premium and attracted fewer fishermen to join. Consequently, most insurance companies pulled out, leaving the PICC alone, offering a very limited range of services.[13] As a result, fishery insurance was gradually abandoned by the PICC due to the large losses. Only two types of products related to fishery insurance remained: insurance of large fishing vessels and employer's liability insurance.

By examining the previous data, Chinese scholars argue that two fundamental problems of private insurance led to its failure in the

[7] The above data considering fishing fatalities in China is collected from the website of MOA, available at http://www.moa.gov.cn/ztzl/wnmbss/201401/t20140123_3747712.htm (in Chinese) (last accessed on December 3, 2019). Besides, according to the estimates of the International Maritime Organization, the FAO and the National Institute for Occupational Safety and Health (NIOSH), the fishing fatalities related to marine fishing activities are 160–180/100.000 per year. According to the CFMI, up to 2011, the fatality of fishermen was 120/100.000 per year, and the injury rate was 832/100.000 per year, far beyond the rate of people engaged in other high risk sectors, such as coal mining or the construction industry. It seems plausible that the fatality rates in countries for which data is not available might be higher than it is in those that do keep records. More information on fishing fatalities is available at https://www.cdc.gov/niosh/docs/2017-171/pdf/2017-171.pdf (in Chinese) (last accessed on December 11, 2019).

[8] See Sun Y. (2006). On the risks of fishing men and fishery insurance (in Chinese), *Chinese Fisheries Economics Insurance Economics*, No. 2, pp. 59–63. According to Sun's argument, the real economic losses and the fishing fatality is much higher than the official data. There is a high possibility that a great number of accidents related to fishery activities were not reported by the fishermen; which means, such accidents are not included in the official record, and many unregistered fishing vessels are also excluded from the statistics. Moreover, due to lack of supervision, owners of quite a few medium- and small-sized vessels choose to escape from punishment by concealing accidents. Based on Sun's estimate, the annual rate of the dead and missing is between 1496 and 4,166, and the fatality rate of people who engaged in fishing would be 140–164/100.000. The fatality rate of fishermen and related fishing workers is 24 times higher than that of coal workers and 35 times higher than that of workers in the construction industry.

[9] The statistical report of national fishery in China in 2018, available at http://www.cappma.org/view.php?id=3047 (in Chinese) (last accessed on December 2, 2019).

[10] People's Insurance Company of China Holdings Company (中国人保控股公司) is a state-owned company in China.

[11] The first guidance is t*he Notice of Implementing Nationwide Fishing Vessel Insurance* (关于开展国内渔船保险工作的通知) was jointly issued by the Ministry of Agriculture, Animal Husbandry & Fishery (replaced by the Ministry of Agriculture since 1988, and then by the Ministry of Agriculture and Rural Affairs since 2018) and the PICC in December 1983. It required that all the departments related to the fishery sector should encourage fishing vessels to purchase commercial insurance. The second guidance is t*he Provisions on National Fishing Vessel Insurance* (国内渔船保险条款) was issued by the PICC in November 1981.

[12] In 1985, there were China Pingan Insurance (Group) Company Ltd.(中国平安保险(集团)股份有限公司), China Life Insurance Company Ltd. (中国人寿保险股份有限公司), and a few foreign commercial insurance companies initiated fishery insurance products.

[13] Zheng Hui, Mu Hairong, Zhao Xin (2018), Evaluating the demand for aquaculture insurance: an investigation of fish farmers' willingness to pay in central coastal areas in China, *Marine Policy*, Vol. 96, pp. 152–162.

fishery sector: a high loss ratio and low participation.[14] First and foremost, the payout/loss ratio of fishery insurance, which is the ratio between insurance losses incurred and premiums earned in a given period, was far beyond the point that a private market can bear. By the end of 1995, the insurance of fishing vessels accounted for less than 1% of the whole market of vessel insurance. The premium income in 1995 was CNY 47 million, and the loss ratio was 107%, which was much higher than that in the classes of insurance regarding other vessel types.[15]

Moreover, the rate of purchasing insurance was low. In 1986 only, 25.436 out of 239.000 fishing vessels were insured, the ratio of which was 10,6%, and it decreased to 5,8% (16.000 out of 273.978 fishing vessels were insured) in 1995.[16] Moreover, the majority of insured ships were medium- and small-size fishing vessels owned by companies and individual fishermen, while few vessels owned by State-owned companies were insured.

2.2. FMI: an attempt towards risk-sharing

Since private insurance for the fishery sector was thus deemed unsuccessful,[17] the Ministry of Agriculture and Rural Affairs and the Ministry of Civil Affairs jointly determined to establish a non-profit social organization called China Fishing Vessel Owner's Mutual Insurance Association in July 1994, which was renamed as the China Fishery Mutual Insurance Association (hereinafter CFMI) in October 2007.[18] The CFMI aims to promote a financial mechanism to share risks between the owners of fishing vessels, fishermen and fish farmers, as well as other shareholders related to fishery activities. All the individual fishermen, owners of fishing vessels, and fishery companies can join the association on a voluntary basis. Over the past 26 years (1994-now), fishery mutual insurance (FMI) has gone through a series of continued adjustments in terms of both programs and practices. It has gradually replaced private fishery insurance in China.

FMI is similar to insurance as it also covers fishery risks via pooling. However, in the case of FMI, it is the risk creators (which are fishermen and fishery companies), but not commercial insurers that aggregate resources to provide coverage for their risks.[19] The risk-sharing model among risk creators is reiterated by the *Pilot Measures for the Supervision and Administration of Mutual Insurance Organizations* (hereinafter *Mutual Insurance Measure)*[20] in 2015, where it describes FMI more like a risk-sharing agreement than like insurance. It is because FMI associations aim at sharing risks among fishermen themselves via pooling rather than to resort to a third party the insurance company. The adoption of the term 'fishery mutual insurance' (in Chinese:渔业互助保险) to represent this risk-sharing agreement is slightly misleading as risk-sharing has to be distinguished from insurance, pursuing risk guarantee from a third party.[21] Fishermen establish a risk-sharing agreement by joining the association and paying the membership fees as the contribution. The contribution is similar to the premiums charged by commercial insurers in a private insurance setting, the amount of which is different under specific circumstances, depending upon the factors like the size of vessels, the accident records in the past, etc.[22] In cases where one member suffers from losses during fishery activities, other members will intervene in the compensation of the covered risks via pooling. As the fundamental aim of FMI is to provide a risk-sharing mechanism at an affordable price. The price of membership fees excludes profit. Therefore, fishermen under FMI are awarded compensation at a lower cost compared to private insurance.[23]

The resources of FMI mainly include (a) membership fees, which are contributions collected from individual members, and (b) governmental subsidies. Apart from interests received from the bank and charitable donations, FMI associations also promote micro-finance services in the fishery industry to activate the funds, which include micro-credit, micro-deposit, and micro-insurance. To be precise, FMI associations make use of deposits to provide services for the family aquaculture and small-scale vessel owners who find it difficult to get loans from formal financial institutions. As fishery micro-finance providers, FMI associations not

[14] For example, Ge Guanghua, Lou Yong (1997), Current Status and Prospect of China Fishery Insurance (in Chinese), *China Fishery and Economy Research,* vol.6, pp.22–24; also see Zheng Hui, Mu Harirong, Zhao Xin (2018), Evaluating the demand for aquaculture insurance: an investigation of fish farmers' willingness to pay in central coastal areas in China, *Marine Policy*, vol. 96, pp. 152–162; Chen, Shengwei, Wang, Xiaoli, (2017), Literature Review on the Chinese Fishery Mutual Insurance (in Chinese), *Journal of Ocean University of China (Social Science part)*, vol.2, pp.67–70; Jia Qingru, Chen Shengwei (2015), Analysis of the Development and Dilemma of Fishery Insurance in China (in Chinese), *Shandong Agriculture Science,* 2015, 47(8), pp. 148–152, 156; a discussion of these problems is provided in *infra* section 4.

[15] Ge Guanghua, Lou Yong (1997), Current Status and Prospect of China Fishery Insurance (in Chinese), *China Fishery and Economy Research*, vol. 6, pp. 22–23.

[16] *Ibid.*

[17] Zheng Hui, Mu Harirong, Zhao Xin (2018), Evaluating the demand for aquaculture insurance: an investigation of fish farmers willingness to pay in central coastal areas in China, *Marine Policy*,vol. 96, pp. 152–162.

[18] The Ministry of Civil Affairs made the decision to establish the CFMI, and it is a non-profit organization regulated by the Ministry of Agriculture and Rural Affairs. See Tuo Guozhu (2012), The improvement and development of Fishery Mutual Insurance in China (in Chinese), *Journal of Insurance Professional College,* vol.26 no.1, pp.5–11.

[19] Doucette, J. E. (2002). Wading in the pool: Interlocal cooperation in municipal insurance and the state regulation of public entity risk sharing pools-A survey. *Connecticut Insurance Law Journal,* vol. 8 (2), pp. 533–568.

[20] *Pilot Measures for the Supervision and Administration of Mutual Insurance Organizations* (相互保险组织监管试行办法) was issued by the China Insurance Regulatory Commission (was replaced by China Banking Insurance Regulatory Commission in 2018) on Jan 23, 2015. Article 2 states that 'mutual insurance means the insurance activities whereby entities or individuals with the same kind of risk protection demand become members by entering into a contract. All the members pay insurance premiums to form a mutual fund that compensates for losses incurred from any incident specified in the contract.' Besides, 'mutual insurance organization means an organization owned by its members and providing insurance service for its members in the form of cooperation on the basis of equality, free will and democratic management, including general mutual insurance organizations, and specialized or regional mutual insurance organizations, among others.'

[21] See further on the differences between risk-sharing agreements and insurance, Liu, J. and Faure, M.(2018), Risk-sharing agreements to cover environmental damage: theory and practice, *International Environmental Agreements*, vol. 18, pp. 255–273.

[22] See the *Policy of Employer's Liability Mutual Insurance of CFMI* (2017). Also see the *Policy of Fishing Vessel Mutual Insurance of CFMI* (2017).

[23] Generally speaking, fishermen pay approximately several hundred to several thousand of RMB (= approx.dozens to hundreds of euros) for personal accident mutual insurance or fishing vessel mutual insurance on the contribution, the amount of which varies between different towns and provinces. For example, in Dongshan District of Fujian Province, subsidies from Fujian Province and Dongshan County are respectively covered 30% and 10% of the contributions in 2014, while the shipowner undertakes the rest 60% of the contribution. All the workers on the fishing vessel can get a CNY 150,000 compensation for accidental injury after paying CNY 198 to their shipowners, meaning the money paid to FMIs are from both employers and employees. The compensation on medical expenses is capped at CNY 15,000 The above data is reported by the CFMI, available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=show&catid=30&id=45 (in Chinese) (last accessed on December 11, 2019).

only take advantage of liquidizing the funds but also provide an alternative for those low-income households to start their fishery business.[24] Considering the non-profit feature of FMI associations, strict requirements are set to restrict their business.[25]

The territorial scope of FMI covers all the coastal provinces, and key inland provinces specialized in the fishery industry in China. Currently, CFMI has founded local offices in three sea areas (i.e., Huang-Bo Sea area, East Sea area, South Sea area) and over twenty provinces and cities.[26] In the meanwhile, nine coastal provinces and cities that are principally engaged in fishery established their respective FMI associations, namely Liaoning, Hebei, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan provinces and Ningbo city (subject to Zhejiang province). Note that the offices in the local areas are subject to CFMI and undertake specific tasks required by CFMI. By contrast, nine FMI associations of local regions are separated from CFMI and take risks on their own, but they may take guidance from the CFMI. In other words, a risk pool created by a local FMI association is isolated from the CFMI or other eight local FMI associations, which means, it has to carry the burden alone in case an accident occurs.[27] The organizational structure of the risk-sharing in the fishery sector is therefore rather diffuse: the (central) CFMI has local offices in many provinces, but in addition some provinces and cities created their own FMI associations, which are not related to the CFMI. Later it will be explained that there are different models of organization, depending upon the specific provinces.[28] The fact that each FMI principally works on its own may weaken the capacity of controlling and remedying risks, especially when the fishery losses are too large for the risk pool of one local FMI association.

The Chinese government expects that FMI can provide a financial alternative for individuals and companies that engage in fishery activities to share potential risks and compensate losses in cases where damage occurs. According to the data published by CFMI, the overall loss ratio of FMI between 2001 and 2007 was around 40%, which was much lower in comparison to that of private fishery insurance of the PICC (100%) or other private insurance products mentioned above.[29] The data from the MOA reveals that 5,78 million fishermen and 360,000 fishing vessels were insured via FMI from 1994 to 2010, providing a total cover of CNY 385 billion.[30] By the end of 2014, the total compensation payment provided by FMI was CNY 3,3 billion.[31]

However, only 30% of fishermen and 25% of fishing fleets were covered by FMI. A pilot program of aquaculture also had a limited coverage purchased by several large companies. The covered area under the FMI program was around 53,360 km^2 in 2012,[32] covering no more than 1% of China's total aquaculture area.[33] Given that the majority members of FMI associations are individual fishermen or owners of medium- and small-scale fishing vessels, the risk pool created by them was relatively limited to share substantial risks.

2.3. Government subsidies

2.3.1. Central subsidies

In order to expand the coverage of FMI and enhance its capabilities of undertaking risks, the MOA issued the '*Notice Regarding the Pilot Project of the Central Government's Contribution Subsidies for Fishery Mutual Insurance*' in 2008.[34] It was the first time that the government initiated a pilot program aiming at subsidizing the fishery sector. The total amount of subsidies by the central government reaches CNY 10 million per year, aiming at two products: fishing vessel insurance with a coverage in case of total loss only and personal accident mutual insurance of fisherman, which is jointly offered by the central and local governments.[35] It initiated a trial of subsidized programs in key coastal provinces that are engaged in fishing, among which the program of fishing vessel mutual insurance was developed in seven coastal provinces. One county of the Zhejiang Province initiated a trial program of personal accident mutual insurance.[36] Fishermen were entitled to receive contribution subsidies that cover 25% of fishing vessel mutual insurance and personal accident mutual insurance,[37] and the maximum compensation amount in the second scenario reached CNY 200,000 per person. After a six-year attempt, as the subsidy on contributions benefits a growing number of fishermen, the Central Government decided to reduce subsidy rates of

[24] Xiaojing Wang (2015), Micro-finance in Fisheries in China (in Chinese), *Open of Social Sciences*, vol. 3, pp. 1–4.

[25] Article 4 of the *Mutual Insurance Measure*.

[26] FMI local offices are located in over twenty provinces and cities, including Tianjin, Jilin, Heilongjiang, Shanghai, Anhui, Henan, Hubei, Hunan, Guangxi, Chongqing, Sichuan, Guizhou, Yunan, Hainan. A distribution map is available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=lists&catid=14 (in Chinese) (last accessed on December 11, 2019).

[27] Wan Jie (2012), Problems and countermeasures of fishery mutual insurance in China (in Chinese), *Chinese Fisheries Economics*, vol. 30 (6), p.18–22.

[28] See *infra* section 2.5.

[29] The original data of the figure is from the Chinese Fishery Yearbook of 2007. The loss rates were respectively 49% (2001), 55% (2002), 42% (2003), 40.42% (2004), 38.49% (2005), 53% (2006). Also see, Jia Xianfei, Liu Haiying, Tong Chunfen (2012), Necessity and Policy Option of Government Intervention of Fishery Insurance (in Chinese), *Guihai Tribune,* vol.28, pp. 90–94. Note that this concerns the performance of FMI from 2001 to 2006, before the involvement of government subsidies.

[30] Xinhua News, The accumulative total cover offered by fishery mutual insurance in China reached CNY 385 billion(2011-11-03), available at http://www.gov.cn/jrzg/2011-11/03/content_1985308.htm (in Chinese) (last accessed on March 21, 2020).

[31] China Ocean News, The amount of government subsidies on FMI reaches CNY 3.3 billion (2015-12-15), available at http://www.oceanol.com/jingji/jinrongtouzi/2015-12-15/54395.html (in Chinese) (last accessed on March 21, 2020).

[32] It was reported that the covered area under the FMI program was 80,000 mu^2 in 2012, which equals 53,360 km^2, the former of which is a traditional unit of measurement in China. Generally, 1 mu^2 is equal to 667 m^2.

[33] Qin Liu, Zhai Liushuan (2015). On the Current Status and Development of Aquaculture insurance (in Chinese). *Fishery Information & Strategy*, vol.30 (1), pp.10–16.

[34] Early in 2004, the central government prompted a policy-oriented program on agriculture insurance and selected several provinces to develop this pilot program with government subsidies. In 2008, the *Notice Regarding the Pilot Project of the Central Government's contribution Subsidies for Fishery Mutual Insurance* (农业部关于下达2008年渔业互助保险中央财政保费补贴试点项目资金的通知) was issued by the MOA.

[35] Although the central government initiated the subsidy program in 2008, there was a financial gap in practice. It was reported that the gap reached CNY 26 million after a six-year attempt (from 2008 to 2013), among which the funding gap in 2013 was around CNY 5.5 million. In order to raise sufficient money for the program, the local governments were also asked to bear the duty of providing subsidies. Since 2011, except for Hainan Province, whose government has been able to cover the financial gap on its own, all other provinces deal with the gap with the CFMI together. See Fishery Department of the Ministry of Agriculture (MOA), see http://www.moa.gov.cn/ztzl/wnmbss/201401/t20140123_3747712.htm (in Chinese) (last accessed on January 19, 2020).

[36] Generally, the seven coastal provinces have a better performance in economic growth, including Liaoning (辽宁), Shandong (山东), Jiangsu (江苏), Zhejiang (浙江), Fujian (福建), Guangdong (广东) and Hainan (海南) Province. The program selected the Daishan County of Zhejiang Province (浙江省岱山县) as the only area to initiate the experimental program of personal accident mutual insurance in 2008. In 2013, the central government decided to expand the trial program of fishing vessel mutual insurance to two more areas- Tangshan City of Hebei Province (河北省唐山市) and Qinzhou City of Guangxi Province (广西省钦州市)- in addition to the seven provinces.

[37] CFMI, The significant events of China Fishery Mutual Insurance Association in 2008, available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=lists&catid=74 (in Chinese) (last accessed on December 3, 2019).

both mutual insurance from 25% to 20% in 2013, keeping the total amount of the subsidy at CNY 10 million.[38]

2.3.2. Local subsidies

In response to the national policy, local governments not only spare a certain amount of money to the subsidies of CNY 10 million with the central government but also establish particular funds to subsidize the FMI on their own.[39] The amount of money provided by all levels of local governments to support the trial programs reached CNY 86,8 million in 2008.[40] While the subsidy on contributions for fishery and aquaculture had yet to be included in the central budget, there were *de facto* several local areas providing budgetary allocations for contribution subsidy to fishery and aquaculture mutual insurance, such as Zhejiang, Fujian, Hainan.[41] Furthermore, several provinces and cities became pioneers in subsidizing aquaculture mutual insurance, including Shanghai City, Chengdu City (of Sichuan), Shishi City (of Fujian), Jiangsu, Zhejiang, etc. The subsidy on contributions can come either from the local government or their FMI associations.[42]

The subsidy rate of contributions varies from place to place based on their economic development status, ranging from 20% to 80%. The subsidy, as expected, has encouraged more fish farmers to join the FMI. The high percentage of subsidy for aquaculture (above 50%) in several provinces (i.e., Sichuan, Jiangsu, and Shanghai) proved to be a strong incentive for participation.[43]

According to the official statement, the development of FMI increased as a result of government subsidies. The number of insured fishermen and fishing vessels in 2013 increased respectively by 85% and 90% in comparison with those in 2007. By the end of 2013, 21.220 fishing vessels and 21.267 fishermen enjoyed the subsidies nationwide.[44] However, the number of fishermen that benefited from this subsidy merely accounted for 2,5%. Although fishermen from relatively developed provinces (such as Shanghai, Zhejiang, Shandong) may also receive contribution subsidies from their local governments, the remaining fishermen have to pay the full price for the contribution without subsidies, which drives plenty of them to take risks on their own rather than joining FMI associations. Reportedly, the rates of purchasing fishing vessel or personal accident mutual insurance were respectively 20% and 40% in 2013. This relatively low coverage prevented the further expansion of FMI.[45]

2.4. Partnership with commercial insurers

Although private insurance was proven to be unsuccessful and was then abandoned in the early 1990s, it became increasingly clear that FMI was also faced with similar problems as private insurance: a relatively high contribution and a limited number of participants. Even with the subsidies from the government, FMI associations, as non-profit organizations, still had limited financial capabilities to provide sufficient funds. It is against this background that several provinces also paid attention to insurance companies again. This time, instead of promoting a purely private market, insurance companies either jointly insure fishery risks with FMI associations or undertake reinsurance.[46] The reason behind this is to control the losses that FMI associations may potentially suffer. In other words, insurance companies will prevent FMI associations from financial ruin, thereby protecting fishermen and owners of fishing vessels from under-compensation.

2.5. Four models of FMI in practice

With the involvement of the government, the fishery sector in China is currently operated by both FMI associations and commercial insurers.[47] Local governments have been following the central government to step in providing various subsidies to their FMI associations in recent years, and these associations are currently in the process of attempting an appropriate approach to fit in with their actual situation. Therefore, they may not stick to one model but could adopt several models depending upon the specific products they offer. The samples introduced below are not the only models in that area, but typical cases initially developed in that area and are therefore worth examining.

The first model is that CFMI and local FMI associations jointly establish a risk pool to share risks mutually. The governments of Ningbo and Zhejiang respectively started subsiding FMI in 2005 and 2012, and the business is in the hands of local FMI Associations.[48] Although receiving subsidies from the government, the associations run their business independently.

The second model is also jointly run by CFMI and local FMI associations, but the relationship between them is not coinsurance but reinsurance. In Shandong Province, a reinsurance arrangement is made between the local FMI Association and the CFMI so as to mitigate risks and limit the losses arising from insured fishery activities. Since 2008, the Shandong Provincial Oceanic and Fishery Department has decided

[38] Fishery Department of the Ministry of Agriculture (MOA), the information is available at http://www.moa.gov.cn/ztzl/wnmbss/201401/t20140123_3747712.htm (in Chinese) (last accessed on December 11, 2019).

[39] CFMI, The significant events of China Fishery Mutual Insurance Association in 2008, available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=lists&catid=74 (in Chinese) (last accessed on December 3, 2019. All levels of local governments include governments at the provincial, municipal, and county levels.

[40] See Lu Li (2012), The Study of Financial Policy on the Development of Liaoning Marine Economy (in Chinese), Liaoning Academic Project (Project number: 11C026), pp.11–12. Also, see Wan Jie (2012), Problems and countermeasures of fishery mutual insurance in China (in Chinese), *Journal of China Fishery Economy*, vol. 6, p. 18.

[41] Yuan Xinhua, Tipparat Pongthanapanic et al. (2017), Fishery and aquaculture insurance in China, FAO Fisheries and Aquaculture Circular No. 1139, Food and Agriculture Organization of the United Nation (FAO). Pp. 28–29.

[42] See, A summary of all the policies concerning aquaculture insurance in China (in Chinese), *Journal of China Fishery Mutual Insurance* (2014), vol. 3, p. 21.

[43] Yuan Xinhua, Tipparat Pongthanapanich et al. (2017), Fishery and aquaculture insurance in China, FAO Fisheries and Aquaculture Circular No. 1139, Food and Agriculture Organization of the United Nation (FAO). Pp. 28–29.

[44] Fishery Department of the Ministry of Agriculture, The subsidies the from Central Government improves the fishery activities (2014-01-23), available at http://www.moa.gov.cn/ztzl/wnmbss/201401/t20140123_3747712.htm (in Chinese) (last accessed on December 11, 2019).

[45] CFMI, To involve fishery mutual insurance into the scope of the subsidies given by Central Government (2014-03-11), available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=show&catid=42&id=732 (in Chinese) (last accessed on December 11, 2019).

[46] See *infra* section 2.5, where specific examples of both models are introduced.

[47] Zheng Hui, Mu Harirong, Zhao Xin (2018), Evaluating the demand for aquaculture insurance: an investigation of fish farmers' willingness to pay in central coastal areas in China, *Marine Policy*, vol. 96, pp. 152–162.

[48] The guidance on FMI in Ningbo City and Zhejiang Province are provided by local administrative measures, namely the *Measures for the Administration of Fishery Mutual Insurance in Ningbo City* (宁波市渔业互助保险管理办法), *Interim Measures for the Management of Social Funds for Subsides for Fishery Mutual Insurance* (浙江省政策性渔业互助保险补贴专项资金管理暂行办法), and the *Notice of Strengthening the Pilot Program of Aquaculture Mutual Insurance of Zhejiang Province'* (浙江省水产养殖互助保险试点实施方案). The full text is available at http://www.zfmi.com/zfmi/news/2017041000002.html (in Chinese) (last accessed on December 12, 2019).

to allocate CNY 6 million to the Association.[49] Therefore, the mutual is run by the local FMI Association with a subsidy from the Shandong Government, but reinsurance is provided by the (central) CFMI. Meanwhile, according to the announcement by the Shandong Provincial Tax Bureau, the contributions received by the Shandong FMI Association are exempted from business tax as a form of financial support from the government. The Guangdong FMI Association has also started a similar reinsurance model since 2006. However, it only receives direct subsidies from the government, and no tax privileges are given.

Commercial insurers and CFMI create the third model. Since 2006, the Shanghai Anxin Agricultural Insurance Company (hereinafter Anxin Company)[50] and CFMI have financed fishing vessel mutual insurance with the proportion of 1:1, among which Anxin Company is in charge of collecting contributions and compensating claims, while the CFMI Shanghai Office takes care of procedural issues, such as contacting the government and implementing policies.[51] The basic products-fishing vessel mutual insurance and personal accident mutual insurance are covered under this model (later expanded to aquaculture mutual insurance). In the meantime, as a commercial insurer, Anxin Company also develops private insurance of agricultural products that can bring benefits, in which way to balance the relatively high loss ratio of FMI. Similarly, CFMI also develops this model in Fujian Province by inviting a commercial insurer, Fujian PICC.[52]

The fourth model is adopted by Hainan Province, where the CFMI instead of a commercial company becomes the main party under the fishing vessel mutual insurance and personal accident mutual insurance.[53] With the assistance of commercial insurers, the Hainan CFMI Office is responsible for providing policies, handling cases, and compensating claims. For example, the Hainan FMI Association promotes two levels of the compensation amount: A and B.[54] Fishermen with A level enjoy a total compensation of CNY 260.000, consisting of CNY 250.000 for personal injury and CNY 10.000 for medical expenses. The contribution to this coverage is CNY 600. By comparison, fishermen with B level can receive a maximum of CNY 520.000 in compensation, of which CNY 500.000 for personal injury and 20.000 for medical expenses. For this coverage, the contribution is paid of CNY 1.200.[55] In Hainan, the contributions to be paid by fishermen are subsidized up to 60% so that fishermen only need to pay 40% of the contribution, which amounts to CNY 240 and CNY 480 receptively to enjoy the coverage.[56]

FMI currently dominates the fishery sector in China with a proportion of 95% shares of the insurance market, while commercial fishery insurance only serves a complementary role that provides little coverage and holds less than 5% shares, including large-scale fishing vessel insurance and employer's liability insurance.[57] Compared to the pure private market, FMI, especially subsidized FMI, seems to have a better performance of handling risks arising from fishery activities in China.[58]

3. Analysis

3.1. Starting points

The case of risk-sharing between fishermen in China is an interesting one from the perspective of the law and economics literature on the choice between insurance and risk-sharing,[59] but also from the perspective of the economic literature related to first party insurance for disasters.[60] The demand of fishermen for cover can be related to a wide variety of risks, such as personal injury, damage to or loss of the vessel or pure economic loss, for example resulting from dramatic weather conditions, typhoons or hurricanes. Some of these risks may be systemic, in the sense that the risks are correlated and may not just happen to one fisherman, like in the case of a typhoon,[61] but other risks may just relate to that particular fisherman (for example losses due to mechanical failure of the vessel). The starting point is that especially for larger losses, fishermen will have a demand for cover as they will more particularly be averse against the risks of those larger losses. This cover can be provided either through commercial insurance or through risk-sharing whereby the case of the Chinese fishermen shows that risk-sharing (the FMI) apparently succeeded where insurance failed. The law and economics literature may provide an explanation for that.

3.2. Demand and supply for disaster insurance

Empirical evidence has demonstrated that individuals often underinsure for disasters. This was, for example, shown for the 'flood of the century' of the River Elbe in Germany[62] as well as especially in the US after Katrina.[63] Several reasons are indicated for this low demand for disaster insurance. First, as a result of cognitive limitations, low probability events like natural disasters are systematically misjudged, resulting in an "it will not happen to me" attitude.[64] Second, people often prefer *ex ante* uncertain losses, rather than the certain loss incurred by paying the premium. Disaster insurance is wrongly considered as an "investment" and since there may be no return on the "investment" during a lifetime, there can be low demand.[65] Third, some literature indicates that also *ex post* government relief (i.e., provided after a disaster) may reduce incentives to purchase insurance coverage.[66]

[49] Yang Wensheng (2012), The research on operating conditions of the fishery mutual insurance of Shandong Province (in Chinese), *Insurance Studies,* No. 6, pp. 49–57. The announcement of the tax exemption for the Shandong FMI Association was issued in August 2006.

[50] Anxin Agricultural Insurance Co Ltd. (上海安信农业保险公司) was founded in Shanghai in 2004. It is the first specialized agricultural insurance company, providing insurance services for agriculture, rural areas and farmers living in the city.

[51] Sun Yingshi (2008), Several models of subsidized FMI in practice in China (in Chinese), The Proceedings of the Chinese Fisheries Economics Forum in 2008, pp. 31–36.

[52] *Ibid.*

[53] Zheng, Zailin, CFMI Hainan office, An introduction of fishery mutual insurance in Hainan province (2019-03–04), available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=show&catid=20&id=2831 (in Chinese) (last accessed on Nov 26, 2019).

[54] Clause 9 of the *Policy of Personal Accident Mutual Insurance of Hainan FMI Association* (2019) (海南省渔民共保体渔民海上人身意外伤害保险条款).

[55] *Ibid.*

[56] *Ibid.*

[57] Dong, Chenghui, (2016), A Study on the Commercial Fishery Insurance in China (in Chinese), *Journal of China Insurance,* vol. 5, pp. 36–39.

[58] *Ibid.*

[59] See *inter alia* Liu J., Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics,* vol. 18 (2), pp. 255–273.

[60] See Kunreuther, H.(1996), Mitigating disaster losses through insurance, *Journal of Risk and Uncertainty*, vol. 12, pp. 171–187.

[61] See further Faure M., Hartlief T.(2003), Insurance and expanding systemic risks. *Financial Market Trends*, pp.145–156.

[62] Endres, A., Ohl, C., & Rundshagen, B. (2003). Land unter. In Ein institutionenökonomischer Zwischenruf, List Forum für Wirtschafts-und Finanzpolitik Bd, vol. 29, pp. 284–294; Schwarze, R. and Wagner, G.(2004) ,In the Aftermath of Dresden. New directions in German flood insurance, *Geneva Papers on Risk and Insurance*, vol. 29 (2), pp. 154–168.

[63] Daniels, R.F., Kettl, D.F. et al. (2006), On risk and disaster: lessons from hurricane Katrina, Philadephia, PA, University of Pennsylvania Press.

[64] Kunreuther, H.(1996), Mitigating disaster losses through insurance, *Journal of Risk and Uncertainty*, vol. 12, p. 175.

[65] Slovic, P., Fischoff, B. et al. (1977), Preference for insurance against probably small losses: insurance implications, *The Journal of Risk and Insurance*, vol. 44, pp. 237–258.

[66] It is a point especially made by Epstein, R.A. (1996), Catastrophic responses to catastrophic risks, *Journal of Risk and Uncertainty*, vol. 12, pp. 287–308.

Problems may not only occur on the demand-side but on the supply-side as well. Given the "difficult to predict" nature of disasters and more particularly the correlation that may occur in case of catastrophes, they could endanger the financial viability of insurance companies.[67] Given the uncertainty (also related to the low probability of disasters), insurers may add a risk premium to deal with insurer ambiguity,[68] resulting in high premiums. If premiums are high, that may result in lower demand. The end result can first of all be that there is no demand for the insurance, at least not against the premiums that insurers are charging. The second problem is that only a few insured may be interested in taking cover, resulting in a relatively small risk pool, which subsequently endangers the risk-spreading. As risk spreading (either via insurance or risk-sharing) relies on the law of large numbers, a sufficiently large risk pool is necessary in order to be able to provide cover.

Those problems typically also occurred in the insurance of fisheries in China. Also fishermen may have weak awareness of their exposure to risk and may consider the probability of catastrophic loss as very unlikely as a result of which a too low demand would occur. That may endanger the constitution of a large enough risk pool. Of course the question arises whether some of those problems can more easily be remedied within the context of a risk-sharing agreement than via traditional insurance.

3.3. Risk-sharing versus insurance in handling moral hazard and adverse selection

Every type of financial coverage, either via insurance or via risk-sharing, entails the risk of moral hazard. Moral hazard means that the risk creators' motif to prevent loss tends to change after obtaining the coverage since the risk of paying large amounts of losses is removed or reduced.[69] It can come under two angles: before the accident (*ex ante*) fishermen may no longer sufficiently invest in risk reduction as a result of the coverage provided; after the accident (*ex post*) moral hazard may imply that a fisherman attempts to obtain benefits that he is not entitled to.[70] It makes it more difficult for the insurers or the pool to evaluate the actual losses. A real-life example of moral hazard in China concerned a case where fishermen intentionally sank their seafood to the bottom of the sea to create an artificial scene with significant losses. After being compensated by the insurer, fishermen would recover their seafood and restart their business.[71]

Insurance may also be vulnerable to adverse selection, which refers to "the tendency of persons with a relatively greater exposure to risk to seek insurance protection".[72] Adverse selection is the well-known problem that insurance will always be attractive for those with relatively greater risk exposure who will therefore seek insurance protection.[73] If the insurer were unable to narrow risk pools through risk differentiation, premiums would become too high for the good risks which would leave the pool, potentially leading to an unraveling of risk pools.[74] Both problems may also arise under FMI, but can probably be remedied in an easier manner under risk-sharing than under insurance.

The core of a risk-sharing agreement is that risks are not shifted to a third party (an insurance company), but that risks are shared among the members based on an *ex ante* agreement on *ex post* sharing of losses.[75] Members in a risk-sharing pool usually possess similar risks, common knowledge of the possible moral hazard, repeated exchanges and are subject to similar reputational remedies as well as social control.[76]

First and foremost, a crucial element in any coverage system relates to the problems of adverse selection and moral hazard, both of which are related to the lack of information of insurers (or a risk pool) concerning the particular risk posed by specific insured or members in the pool. One advantage of risk-sharing is that, unlike in the case of commercial insurance, full information in order to charge *ex ante* premiums should not necessarily be available. Risk-sharing agreements can deal with uncertain risks for which statistical data are rare. As long as a risk differentiation can be made among the members, a risk-sharing agreement can be feasible since an *ex ante* charging of premiums is in principle not necessary. Only the relative contribution of each member to the pool has to be known. This is *de facto* also how the risk-sharing between fishermen in China works. The (central) CFMI has sub-district offices at local levels, and it is the local fishermen in the same fishing village or neighboring village that constitute the risk pool.[77] In a risk-sharing agreement like FMI all the insured, in this case, are also the insurers. Compared with the relationship between commercial insurers and insured fishermen under private insurance, it is clear that the local fishermen under FMI are more familiar with each other. Consequently, information asymmetry may not be a major concern.

In addition, as FMIs are organized at the level of provinces, they may have good knowledge about the specific location and the circumstances that influence the risk. Thus the operator of the FMI pool may well be able to differentiate premiums according to the specific risk posed by the individual fisherman, thus remedying both adverse selection and moral hazard.[78] FMIs do indeed engage in detailed monitoring as predicted by theory. Monitoring in the case of preventing fishery risks is crucial to ensure that the desirable precaution is taken. The monitoring measures under fishery insurance and risk-sharing agreements operate differently.[79] Under an insurance policy, it is the insurer that monitors the behavior of insured fishermen. By contrast, in a risk-sharing agreement, mutuality is created whereby the contribution paid by one member

[67] See Gollier, C.(2005), Some aspects of the economics of catastrophe risk insurance, in Catastrophic risks and Insurance, Paris, OECD Publishing, vol. 8, pp. 13–30.

[68] Kunreuther, H., Hogarth, R. and Meszaros, J. (1993), 'Insurer ambiguity and market failure', *Journal of Risk and Uncertainty*, vol. 7 (1), pp. 81–87.

[69] Steven Shavell (1979), On moral hazard and insurance, *Quarterly Journal of Economics*, pp. 541–62. Also, see Wagner G.(2007), Un-insurability and the choice between market insurance and public compensation systems, in Van Boom, W.H. and Faure, M. (eds.), Shifts in Compensation Between Private and Public Systems, Vienna, Springer, p. 95.

[70] See generally on moral hazard and its remedies, Shavell, S. (1979), On moral hazard and insurance, *Quarterly Journal of Economics*, pp. 541–562.

[71] Similar examples actually happened in the 1980s in China, which was discussed during an interview with the vice general manager of the PICC Qingdao branch, available at http://finance.sina.com.cn/consume/puguangtai/20110120/17139286425.shtml (in Chinese) (last accessed on December 4, 2019).

[72] Priest, G. (1987), The current insurance crisis and modern tort law, *Yale Law Journal*, vol. 96, p. 1541.

[73] Arrow, K. J. (2001), Uncertainty and the welfare economics of medical care (American economic review, 1963). *Journal of Health Politics, Policy and Law,* vol. 26 (5), pp. 851–883.

[74] Priest, G. (1987), The current insurance crisis and modern tort law, *Yale Law Journal*, vol. 96, p. 1521–1590.

[75] Liu J, Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics,* vol. 18(2), p. 260.

[76] Liu J, Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics,* 18(2), p. 261.

[77] Yang Wensheng (2012), The research on operating conditions of the fishery mutual insurance of Shandong Province, *Insurance Studies*, 6, pp. 51.

[78] This is considered an important theoretical advantage of risk-sharing. See Liu J, Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics,* vol. 18 (2), p. 261.

[79] *Ibid*.

depends on the claims made by all other members.[80] It is in the interests of all other members' claims to be as low as possible, and thus a mutual interest of risk minimization is created.[81] In order to reduce risks, the fishermen of such a group have incentives to differentiate risks. That will imply to align a member's contribution to the risks that each member poses and to monitor each other. A certain level of trust is crucial to building this mutuality. Therefore, members in a risk-sharing pool usually pose similar risks, shared knowledge of the possible moral hazard, repeated exchanges, subject to a similar reputation and other social controls.[82] The fishermen members are faced with the same type of risks and often have more expertise and precise knowledge compared to a third-party insurer.[83] In this sense, they can evaluate the risk that each member creates and can better monitor the behavior of other fishermen members.

Also particular features of FMI are geared towards remedying adverse selection. Theoretically adverse selection can be controlled if private insurers efficiently collect in a risk pool individuals with a narrow range of risk exposure, so the insurance remains financially attractive to each member of the pool.[84] Based on the past performance of fishery insurance in the early 1990s, the private market itself could hardly cure the problem of adverse selection due to unfavorable features of fishery activities. In an FMI setting, as the number of members gradually increases, the pooling funded by their contributions is expanded, which enhances the capabilities of FMI to share risks. Since FMI associations only offer several types of basic products (mutual insurance of fishing vessels and cover for personal injury), and the majority of the members are individual fishermen from the same local area, the risk differentiation and control of moral hazard become more feasible. When fishermen are grouped in a way that those with a similar possibility of loss are charged the same rate, and the contribution to be charged for coverage equals the expected losses for the fishermen being insured, a risk differentiation system can be established. Therefore, more fishermen and owners of small-scale fishing vessels would be willing and also able to pay the price. The problem of asymmetric information is therefore less of a concern with risk-sharing as members of the pool have much better information on the risks posed by each individual member than an insurer.

Another crucial difference between risk-sharing and insurance is that under insurance a premium is paid to the insurer which is not recoverable by the insurer, no matter whether the risk materialized or not. To finance a risk-sharing pool, operators can either make advanced payments or make an *ex ante* agreement to pay retrospective premiums after the damage.[85] If the pool members make an advanced payment, the contributions can be carried over to the following year if there is no accident. In other words: an operator does not lose his contribution if no accident happened. Moreover, compared to a third party insurer, the operators potentially possess better knowledge about the risks, methods of risk-assessment control as well as mutual monitoring. A risk-sharing agreement can therefore help to keep the costs to operate such a compensation mechanism lower, compared to insurance.[86]

The FMIs do not only engage in an *ex ante* risk classification, but also in experience rating (adapting the premium based on the loss experience). Since this FMI is a voluntary mechanism, fishermen members may choose to leave the pool after a term. Alternatively, if they are willing to stay in the pool via renewing their membership, there is an incentive system called 'no-claim bonus' to reward them under specific circumstances. This no-claim bonus (NCB) is a discount in contribution (premium) offered by the FMI associations (insurer) if its fishermen members have not made a single claim during the term of the policy. It is introduced under the policy of fishing vessel mutual insurance by FMI associations of Zhejiang and Ningbo.[87] The policymakers expect this NCB can be an incentive to fishermen for improving their care-taking level during fishery activities, where the possibility of moral hazard can be reduced. The costs of accident avoidance and the accident costs will consequently be reduced.[88] Members of both fishing vessel mutual insurance and employer's liability mutual insurance can only enjoy NCB in cases where no claim has been recorded in the official system within 365 days.[89] In 2017, all the members of the Ningbo FMI Association with no claim were entitled to receive 10% of their contribution as a reward for good behavior.[90]

The control of moral hazard does not only consist in *ex ante* and *ex post* monitoring and an adaptation of the policy conditions. In line with the theory[91] the members of the pool are also partially exposed to risk by applying a deductible. A FMI deductible refers to the amount paid out-of-pocket for the losses before FMI associations will pay the remaining costs. In the *Policy of Employer's Liability Mutual Insurance of CFMI* (2017), the deductible amount of medical expenses is capped at CNY 100 per accident.[92] In contrast, a percentage deductible applies under the *Policy of Fishing Vessel Mutual Insurance of CFMI* (2017). To be specific, in cases where an insured fishing vessel has a total or partial loss caused by collision, the deductible amount is 30% if no liability of any vessel can be proven. The deductible amount is 20% if the accident is due to improper operation of the insured vessel, or 10% if a fire causes the accident in the event of daily activities (i.e., cooking).[93] For example, if a fishing vessel that is insured for CNY 100.000 collides with another vessel, and the owner of this vessel cannot provide any information concerning the potential liability of the other vessel, the deductible policy of 30% applies. Therefore, an amount of CNY 30.000 would be deducted from his claim payment. Applying deductibles in the

[80] Bennett, P. (2001). Mutual risk: P&I insurance clubs and maritime safety and environmental performance. *Marine Policy*, vol. 25 (1), p. 15.

[81] *Ibid.*

[82] Skogh, G. (1999). Risk-sharing institutions for unpredictable losses. *Journal of Institutional and Theoretical Economics (JITE)*, vol. 155(3), pp. 505–515.

[83] Faure, M., & Fiore, K. (2008). The coverage of the nuclear risk in Europe: Which alternative? *Geneva Papers on Risk and Insurance-Issues and Practice*, vol. 33(2), pp. 288–322.

[84] Porrini, Donatella (2015), Risk classification efficiency and the insurance market regulation. *Risks,* vol.3, pp.445–454; also, see Akerlof G A.(1978), The market for "lemons": Quality uncertainty and the market mechanism. Uncertainty in economics. Academic Press, pp. 235–251.

[85] Faure, M. & Fiore, K.(2008), The coverage of the nuclear risk in Europe: which alternative? *The Geneva Papers on Risk and Insurance – Issues and Practices*, vol. 33(2), pp. 301–302.

[86] Liu J., Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics,* vol. 18 (2), p. 262.

[87] Clause 34 of the *Policy of Fishing Vessel Mutual Insurance of Zhejiang FMI Association* (2010), stating that 'insured fishing vessels with no claims during the period of mutual insurance enjoy a privilege of rewards when renewing its policy,' available at http://www.zfmi.com/zfmi/news/20100608142828NIJHXUDKNSVTRVJYVFKVAY.html (in Chinese) (last accessed on December 6, 2019).

[88] Liu J., Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics,* vol. 18(2), p. 257.

[89] The time requirement of no claim in 365 days, meaning no claim is required from January 1 to December 31 in one year.

[90] CFMI, The Ningbo FMI Association promoted a new policy of no-claim bonus in 2017, available at http://www.cfmi.org.cn/index.php?m=content&c=index&a=show&catid=20&id=2460 (in Chinese) (last accessed on December 11, 2019).

[91] More particularly, see Steven Shavell (1979), On moral hazard and insurance, *Quarterly Journal of Economics*, pp. 541–562.

[92] Clause 28 (3) of the *Policy of Employer's Liability Mutual Insurance of CFMI* (2017).

[93] Clauses 29–30 of the *Policy of Fishing Vessel Mutual Insurance of CFMI* (2017).

FMI is done for two reasons: first, to incentivize members to improve their care-taking level and thus mitigate moral hazard; second, to reduce the frequency of handling claims with the compensation claims of small amounts, in order to minimize the administrative costs.

Recall that in the 1980s ship owners were aware of the substantial risks they were exposed to, but they were still unwilling to buy insurance given the relatively high premium and the absence of any incentive for risk prevention (i.e., rewarding the good risks with lower premiums). As a result, the number of insureds became so small that it became virtually impossible to constitute a pool within insurance to cover the risk. That again drove commercial insurers to charge even higher premiums from the limited number of insured. More insured fishermen, especially those with few accident records (people with good risks), tended to leave the pool while the remaining ones were the insureds with bad risks and a high possibility of accidents. In other words, there was thus a tendency of these fishermen in high-risk activities with bad performance records to purchase fishery insurance. In the end, commercial insurers that incurred severe losses could not make ends meet and pulled out of this fishery insurance market. That problem of adverse selection could only be countered through risk differentiation (more particularly also rewarding the good risks to keep them in the pool), but that requires adequate information. That information was apparently not available with the (monopolistic) central insurer (the PICC), but is available with the locally organized risk-sharing pools of fishermen, thus explaining why the risk-sharing FMIs succeeded where the insurance failed.[94]

Risk-sharing agreements have, compared to insurance, quite a few advantages. Yet, it should be understood that those advantages can only be materialized if the specific conditions under which risk-sharing agreements emerge, are also present: usually these agreements emerge between operators who are in some way closely connected, possess similar risks and have good information about the risk profile of the other members and thus are able to engage in mutual monitoring at relatively low costs. For fishermen in particular coastal provinces in China, those conditions may be met, which might explain why risk-sharing agreements emerged.

3.4. Scope of the coverage and prepaid contributions

Section 4.3 already mentioned that via the deductible under FMIs fishermen are still (partially) exposed to risk. This is, as we argued, not a bad thing as it can be an important tool to control the moral hazard. Moreover, there are more limits within the current FMI policies. FMI offers two kinds of basic mutual insurance regarding fishing vessels and personal injury (including employer's liability mutual insurance). Additionally, a pilot program of the aquaculture sector has been initiated in some provinces, and the subsidies on aquaculture are only available in several local governments,[95] but it is excluded from the CNY 10 million subsidy program provided by the Central Government. In practice, there is a gap between the limited coverage provided by FMI and the uncovered risks arising from fishery industries.

There is one other feature of a risk-sharing agreement which is that in theory each member's contribution can be agreed upon on beforehand and only actually paid *ex post*. This feature makes it possible for RSAs to deal with uncertain risks, for which the statistical data about the occurrence are rare, or the probability and size are less predictable.[96] However, under current FMI policies, an *ex ante* charge of contributions is still necessary.[97] In order to minimize costs, potential risk-creators are expected to be given optimal incentives to reduce the accident risk, which means the contributions provided by fishermen members should reflect the actual risks that they create. Since the amount of contribution should be determined in advance, accurate risk-related information is still required in an FMI setting, where *ex ante* information about the probability of a particular risk and its magnitude should be available to allow the calculation of an *ex ante* premium charged.[98] Even though sometimes an FMI mechanism is formulated by a group of fishermen in the same or neighboring fishing village, and the problem of asymmetric information may not be as severe as under commercial insurance, the expenses on information are still needed.

This shows that the FMIs have followed many of the specific features of risk-sharing agreements as they are advanced in the literature, but that some elements, such as the *ex post* determination of the individual contributions have not been followed.

3.5. Systemic risk, correlation and scale

The risks to which the fishermen are exposed can well be of such a magnitude that they could be considered as catastrophic. The capacity of individual insurers may be too limited to deal with catastrophic risk; moreover, when a catastrophe (like a hurricane) happens, there is a danger that all fishermen are equally affected and that there is therefore a high degree of correlation.

The Chinese FMI model has in various ways tried to deal with those difficulties related to the supply of cover. The description of the various models used to implement FMI made clear that multiple instruments are adopted to increase the scale of the coverage. Traditionally reinsurance, pooling by insurers and coinsurance are advanced as remedies to increase the capacity of insurers, especially in case of systemic risks.[99] Various examples are worked out of partnerships between the risk-sharing FMIs and commercial insurers, whereby insurers either co-insure the risk with the FMI or undertake reinsurance.[100] Such a partnership between risk-sharing by operators and commercial insurers does make sense. The primary risk is run by the operators gathered in the FMIs who can through their superior information better engage in mutual monitoring and risk differentiation. Yet, their scale may be relatively limited as a result of which the collaboration with insurers (via co- or reinsurance) may have the advantage of increasing capacity, thus being able to provide cover also for higher amounts. From the models described above,[101] it was clear that a variety of collaborations exist between the central CFMI and the local FMIs (consisting of co- or reinsurance), but also between FMI associations and commercial insurers.

[94] Obviously, we do realize that we are merely suggesting a correlation here and can not prove with absolute certainty that it is only the lacking information with the PICC that caused the failure of insurance for fishermen in the 1990s. The fact that the PICC was (and is) a state-owned monopoly may also have reduced its incentives for adequate monitoring and risk differentiation, probably thus adding to the inefficiencies found.

[95] See *supra* section 2.3.

[96] Liu J, Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics*, vol.18 (2), pp.255–273.

[97] See Clause 20 of the *Policy of Fishing Vessel Mutual Insurance of CFMI* (2017), where it states that *'members should pay out the contribution in a lump sum. The contract will not come into enforce until the payout is fully given by the members.'* The similar requirements are also given under Clause 4.1of the *Policy of Personal Accident Mutual Insurance of CFMI* (2017) (中国渔业互保协会渔民人身平安互助保险条款) and Clause 17 of the *Policy of Employer's Liability Mutual Insurance of CFMI* (2017) (中国渔业互保协会雇主责任互助保险条款).

[98] Liu J., Faure M. (2018), Risk-sharing agreements to cover environmental damage: theory and practice. *International Environmental Agreements: Politics, Law and Economics*, vol. 18 (2), pp. 255–273.

[99] See Faure M., Hartlief T. (2003), Insurance and expanding systemic risks. *Financial Market Trends*, pp.145–156.

[100] See *supra sections* 2.4–2.5.

[101] See *supra section* 2.5.

Increasing the scale of the pool is also of importance in order to improve the risk spreading and thus dealing with the risk of correlation.[102] A full integration between the different risk pools has not been realized in China. CFMI runs its business nationwide, but it has over 20 local offices at the local levels, which are isolated from other provincial FMI associations. As a result, in principle each FMI association manages its own pool and only shares the risks within that particular area (unless arrangements of co- or reinsurance would have been concluded).

Usually the fishermen are gathered within their local FMI as these FMIs are also locally organized at the provincial level. However, in case of weather-related disasters, the fishery risks covered by one FMI can also affect the risks of other FMIs, which is precisely the danger of correlation. Since one local FMI may not have a large enough risk pool to compensate for the losses, collaboration with other FMIs is necessary.

This collaboration is especially necessary for systemic risk which could relate to disastrous weather events, hurricanes, floods, earthquakes or major snow storms.[103] An extreme weather disaster, such as a tropical storm or a typhoon which would occur in a sea area in China, can cause enormous damage to a number of individual fishermen and fishery companies in that area. By way of illustration, Typhoon *Maria* crashed ashore in Fujian Province with enormous damages in July 2018, the direct economic loss of which was over CNY 8900 million and at least 109 aquaculture farmers were affected.[104] The Fujian FMI Association was in a partnership with the insurance company (PICC Fujian branch). A total amount of CNY 36.9 million was compensated for these affected aquaculture farmers within one month. With the support of commercial insurers, it seemed possible for a local FMI association to tackle the consequences of a natural disaster. The Fujian Province is a coastal province that frequently experiences weather disasters from May to September. The question arises whether the Fujian FMI Association could handle several compensation claims arising from different typhoons which occurred sometime in the summer. Moreover, the FMI model mentioned only applies to the areas of Shanghai and Fujian, which again indicates the necessity for FMIs to collaborate with commercial insurers via co- or reinsurance. Some FMIs already have worked out those types of collaborations, but others have not. For the latter, an effective supply of sufficient capacity is obviously far more problematic. That raises the question of the desirability of state intervention as it can indeed be found, not surprisingly, in China.

3.6. State intervention

State intervention in the compensation for victims of disasters (either via direct compensation or by promoting insurability) is certainly not only a Chinese feature but can be found in many countries. Provided that the government support would mimic market conditions (for example, via risk differentiation), the support should not necessarily be inefficient.[105]

A first type of state intervention which can be found with respect to the FMIs in China relates to administrative support in the setting-up and running of the FMIs. As mentioned above,[106] the central CFMI is regulated by the Ministry of Agriculture and Rural Affairs and local authorities (more particularly provinces) have been material in the promotion of the FMIs at the level of the provinces. The service offices of fishery mutual insurance (FMI office) are set up at various fishing ports or fishing villages.[107] More importantly, these FMI offices in practice are merged into the bureau of the fishery at local levels. Although the FMI association is a nonprofit organization, this current risk-sharing agreement is highly dependent on the government. A local agency subjected to the bureau of the fishery is usually established to take charge of fishery activities, the duties of which include receiving claims from fishermen, investigating cases, evaluating damages, and settling cases.[108] Generally, the officers of the bureau will undertake the investigation and evaluation, which means the investigator at the accident scene and the administrator of the bureau of fisheries who takes charge of this case is the same person. Although this settlement procedure may solve claims rapidly, it could create another form of moral hazard: corrupt officers may connive with fishermen to jointly file a false claim to the risk-sharing agreement and share the proceeds.[109]

The government (at different levels) therefore plays an active role in the administrative management of the FMIs. The mere fact that the government in many cases stimulated the creation of the risk-sharing agreement can be considered as positive. The problem is that even though the creation of a risk-sharing agreement could in many cases be beneficial, in some cases it simply does not emerge because an orchestrator who takes the initiative to create the risk-sharing agreement is lacking.[110] The role of the government can therefore be important in taking the first step and bringing operators together in the risk-sharing agreement. Moreover, the combination of different tasks (fisheries bureaus and claims management) could equally be beneficial as the government could use the information it acquired in its regulatory capacity to facilitate claim management. There have been other examples where the government intervened in providing disaster insurance and could do so efficiently by combining its regulatory possibilities (e.g., regulating

[102] A further discussion on this problem of correlation in insurance, see Kenneth S. Abraham (2011), Catastrophic Oil Spills and the Problem of Insurance. *Vanderbilt Law Review*, vol. 64, p. 1788.

[103] Skees J R, Barnett B J.(1999), Conceptual and practical considerations for sharing catastrophic/systemic risks. *Review of Agricultural Economics,* vol. 21(2), pp. 424–441.

[104] Li, Wenping, The New considering FMI Compensation for economic losses arising from Typhoon Marina in Fujian Province (2018-07-20), available at http://www.oceanol.com/fangzai/201807/20/c79325.html (in Chinese) (last accessed on December 11, 2019).

[105] For further details see Bruggeman, V., Faure, M.G. & Fiore, K.(2010), The Government as Reinsurer of Catastrophic Risks? *Geneva Papers on Risk and Insurance*, vol. 35, pp. 369–390. Also see, Bruggeman, V., Faure, M.G. & Heldt, T. (2012), Insurance Against Catastrophe: Government Stimulation of Insurance Markets for Catastrophic Events, *Duke Environmental Law & Policy Forum*, vol. XXIII(1), pp. 185–241.

[106] See *supra* section 2.2.

[107] Yang Wensheng (2012), The research on operating conditions of the fishery mutual insurance of Shandong Province (in Chinese), *Insurance Studies,* No. 6, p. 51.

[108] Wu Shuai, Yu Wenbao, Liu Jiazhao (2012), Exploration of Introducing Evaluation Mechanism into Fishery Mutual Insurance (in Chinese), *Journal of Qingdao Mariner College*, vol. 33 (3), pp. 11–13.

[109] *Ibid.*

[110] See Grossmann, S. & Faure, M (2016), Conditions for Effective Risk Sharing against Marine Pollution: The Case of the Ria de Vigo, *Environmental Liability*, vol. 24 (2), p. 59.

disaster risk reduction) and premiums.[111] However, whether the state intervention in the administration of the FMIs and claims handling in the Chinese case is always efficient, is of course questionable, especially when the intervention of corrupt officials could lead to the compensation of unjustified claims.

A second way of intervening in this scheme by the Chinese government consists simply of a direct allocation of money to compensate the affected fishermen after the accident. This type of direct compensation is strongly debated in the literature. To the extent that it merely consists of providing immediate relief after a disaster (such as providing shelter and immediate help), it has been argued that this will not negatively affect the incentives to invest in disaster risk reduction *ex ante*.[112] However, when the government intervention consists of more generous *ex post* compensation, this has been criticized as a "catastrophic response to catastrophic risk".[113] *Ex post* recovery can reduce the incentives to invest in preventive measures; it is referred to as the "charity hazard."[114] A related problem is that victims may be counting on government compensation which may dilute the incentives to purchase insurance or to seek cover via other means. Government-provided compensation can lead potential victims to free ride on the state and dilute the incentives to purchase insurance.[115] These problems are also likely to occur in the case of government compensation to fishermen: the government compensation may lead fishermen to lose their interest in joining an FMI; moreover, the possibility of free-riding on the government could also drive more high-risk fishermen to join the market. In the long run, it can be detrimental to establish a financial mechanism in favor of controlling and sharing risks via pooling. A worse situation is that such a temporary policy, designed to resist fishery risks, could lead to the slack of fishermen's production and even change the motives for FMI.[116]

A third possible way of intervention by the government is to provide subsidies for the payment of the premium. Above section 2.3.2 sketched that in most provinces generous subsidies are provided covering approximately (20%–80%) of the premium.[117] Whereas the law and economics literature is generally critical of direct compensation to victims by the government, the same is not the case for subsidizing insurance premiums. If individuals in disaster-prone areas lack capacity to pay insurance premiums, the government could provide insurance vouchers or victims could be reimbursed by the government for a portion of the increased costs of insurance coverage. The advantage of subsidizing premiums rather than providing direct compensation is that premiums would still reflect risk and would create a risk awareness with the insured. Moreover, through the voucher system individuals could still be incentivized to adopt risk-reducing measures.[118] Coate equally argued that if the government makes in-kind transfers of insurance to the poor, they will not rely on disaster relief *ex post* in case of a loss.[119] The subsidization of insurance premiums can thus avoid the charity hazard.[120]

The government in China uses both subsidies on premiums and financial support to fishermen.[121] Several methods are often mixed to promote FMI. For example, in the Shandong province: the Shandong Oceanic and Fishery Department offers a certain amount of funds to the Shandong FMI Association annually since 2006, where both the association and its fishermen members are covered.[122] Meanwhile, the Shandong Tax Bureau announced to offer policies in favor of fishery mutual insurance, determining that contributions subsidized by the government are exempted from business tax.[123] If the government considers that the affordability of premiums is problematic for particular segments of the population, the better way of intervention is via subsidization of insurance premiums, rather than providing direct compensation of losses to fishermen. Subsidizing premiums still allows premiums to correctly reflect risk (thus raising risk awareness among fishermen) and can promote prevention by making the subsidy dependent upon the implementation of preventive measures.

3.7. A duty to obtain cover?

A general problem with disaster insurance is that risk perception concerning these low probability high damage events is often poor: potential victims often underestimate risks, systematically misjudge the likelihood of a natural disaster, resulting in an "it will not happen to me" attitude.[124] A result is that demand for disaster insurance is often low.[125]

These problems seem to be persistent in the case of fishery insurance in China as well. Under the commercial insurance scheme the coverage

[111] Examples of these types of "efficient monopolies" have especially been studied in the case of the Swiss cantons where state-provided insurance could equally provide incentives for disaster risk reduction. See in this respect especially see von Ungern-Sternberg, T. (2004), Efficient monopolies: the limits of competition in the European property insurance market. Oxford University Press on Demand, p.106. The Swiss model works effectively since the cantons are liable for damage payments as insurers and it provides the cantons with incentives to use their public powers to require preventive efforts. See also Emons, W.(2001), Imperfect tests and natural insurance monopolies, *Journal of Industrial Economics*, vol. 49, pp. 251–255.

[112] Dari-Mattiacci, G., Faure M. (2015), The Economics of Disaster Relief, *Law & Policy*, vol. 37 (3), pp. 180–208.

[113] Epstein, R.A.(1996), Catastrophic responses to catastrophic risks', *Journal of Risk and Uncertainty*, vol. 12, pp. 287–308.

[114] Rachsky, P. and Weck-Hannemann, H.(2007), Charity hazard – real hazard to natural disaster insurance, *Environmental Hazard*, vol. 7, pp. 321–329.

[115] Gron, A. and Sykes, A.O.(2002), A role for government? *Regulation*, vol. 25 (4), pp. 44–51.

[116] Zekri S, Mbaga M D, Boughanmi H.(2008), Fishermen willingness to participate in an insurance program in Oman. *Marine Resource Economics*, vol. 23(3), pp. 379–391. Also, see Jia Qingru, Chen Shengwei (2015), Analysis of the Development and Dilemma of Fishery Insurance in China (in Chinese), *Shandong Agriculture Science*, 2015, 47(8), p. 149.

[117] See *supra* section 2.3.

[118] See Kunreuther, H.(2008), 'Catastrophe insurance: challenges for the US and Asia', in Scawthorn, Ch. And Kobayashi, K. (eds.), Asian catastrophe insurance, London, Risk Books, p. 13.

[119] Coate, S.(1995), Altruism, the Samaritan's dilemma and the government transfer policy, *American Economic Review*, vol. 85, pp. 46–57.

[120] Harrington, S.E. and Niehaus, G. (2001), Government insurance, tax policy and the affordability and availability of catastrophe insurance, *Journal of Insurance Regulation,* vol. 19, pp. 591–612.

[121] Jin Lingen, Li Juan (2003), The promotion of establishing a fishery insurance mechanism with national support (in Chinese), *Chinese Fisheries Economics,* pp. 35–37.

[122] Yang Wensheng (2012), The research on operating conditions of the fishery mutual insurance of Shandong Province (in Chinese), *Insurance Studies,* no. 6, pp. 49–57. The announcement of tax exemption for the Shandong FMI Association was issued in August 2006.

[123] *Ibid.*

[124] Kunreuther, H. (1996), 'Mitigating disaster losses through insurance', *Journal of Risk and Uncertainty,* vol. 12, p. 175.

[125] Faure, M.G. & Bruggeman, V.(2009), Catastrophic Risks and First-Party Insurance, *Connecticut Insurance Law Journal*, vol. 15 (1), pp. 14–26.

amounted to 10.6% in 1986, decreasing to 5.8% of all vessels in 1995.[126] The risk-sharing agreement under the FMIs apparently enabled an increase in the number of fishermen covered, amounting to 20% for fishing vessel mutual insurance and 40% for personal accident mutual insurance in 2013.[127] Yet, a mere cover of 20% still remains relatively low. Also in other cases, it has been found that the mere fact that premiums are subsidized will not automatically increase demand for disaster insurance. One example constitutes the National Flood Insurance Plan (NFIP) in the US. Notwithstanding the fact that premiums for flood insurance under the NFIP received high subsidies the demand for this flood insurance generally remains low.[128] Given the systematic underestimation of disaster risks, Kunreuther argued already in 1968 in favor of mandatory disaster insurance.[129] That then raises the question of whether membership by fishermen in the mutual should be made compulsory. A risk-sharing agreement is, in essence, a voluntary arrangement among business operators. However, in the absence of a duty to join or some other legislation that gives the market a gentle nudge in the right direction, it is likely that the mutual would not come into being or that it would not be able to acquire sufficient members. Mandatory membership could also avoid free-riding (on the government) of those fishermen who have not joined an FMI and would expect to be compensated *ex post* by the government.

4. Concluding remarks

The fishery is a high-risk activity. The perils at sea may lead to personal injury (loss of life or injuries), but also to large economic losses. The ship could be lost in a storm, which often constitutes the only asset possessed by the individual fisherman. Sometimes losses are to one or a few fishermen, but in other cases (especially when losses are related to bad weather events), they could be systemic and even catastrophic, affecting the entire sector. China tried to provide financial compensation to fishermen by creating commercial insurance via the (state-owned) monopolistic insurer. That attempt, however, largely failed due to unsurmountable problems of adverse selection: only high-risk individuals joined the insurance, leading to losses being larger than premium-income. In the 1990s, an alternative was developed, both at the central level and within the Chinese provinces of "fishery mutual insurance" (FMI), basically a risk-sharing agreement between commercial actors active in fishery. Where commercial insurance failed, the risk-sharing agreement seemed to work better, which is largely in line with the literature that indicated that, under particular conditions, risk-sharing agreements may be better able to control risks than insurers, thus remedying the problems of moral hazard and adverse selection.

The Chinese government authorities played an important role in stimulating the creation of FMIs. Again, it had been seen more often that even when risk-sharing agreements between operators could be optimal, they were not always created because there is no orchestrator to take the initiative to launch. This is where government authorities at various levels in China stepped in.

The government, moreover, also subsidizes in different ways. On the one hand, direct compensation to fishermen is provided, which is highly debated given the negative effects it may have on *ex ante* incentives for prevention. The better alternative of subsidizing premiums is also followed. That at least allows a risk-awareness among operators and avoids too strong negative effects for prevention (in the case of outright compensation).

The case of fishery insurance in China is interesting as it shows that in practice the choice is not between either pure commercial insurance or risk-sharing by operators but that various models may exist striving for collaborative solutions between both. In many Chinese provinces commercial insurers still intervene as reinsurers or in coinsurance with the FMIs. That may have the advantage of combining the superior information by the FMIs with the increasing scale facilitated by the intervention of the commercial insurers.

Even though many features of the FMI in China are in line with the law and economics literature, there are also points where the systems deviate and which therefore provide room for improvement. One problem is that currently FMIs are organized at the local level and that there is little integration or collaboration between the different FMIs, which would enable a larger scale of cover. Another problem is that, notwithstanding generous government subsidies on premiums, on average still only 20% of all fishing boats joined the FMIs, still leaving large quantities uncovered (potentially counting on *ex post* government compensation and thus subject to the charity hazard). That raises the question of whether membership in the FMIs should be made compulsory in line with the literature that has pleaded in favor of comprehensive disaster insurance. However, that regulatory intervention also raises a number of questions, among which whether it really corresponds with the preferences of the fishermen (assuming that the lacking demand is the result of lacking information or behavioral biases), as otherwise, the regulatory intervention may amount to paternalism.

The mere fact that many different FMIs exist at local levels in China and that they are organized according to different models (of collaboration with insurers or governments) also provides an interesting scope for a comparative study of these various models. As especially for new and catastrophic risks, where commercial insurers may be reluctant to provide cover, risk-sharing agreements among operators may become increasingly important the case of fishery mutual insurance provides many opportunities to learn from China.

CRediT authorship contribution statement

Minzhen Jiang: Writing - original draft, Writing - review & editing.
Michael Faure: Writing - original draft, Writing - review & editing.

Acknowledgments

The study was supported by the China Scholarship Council (CSC).

[126] See *supra* section 2.1.

[127] See *supra* section 2.3.

[128] Bruggeman, V. (2001), Compensating catastrophe victims: a comparative law and economics approach, Deventer, *Kluwer Law International,* vol. 12, pp. 427–432.

[129] Kunreuther, H. (1968), The case for comprehensive disaster insurance, *Journal of Law and Economics*, vol. 11, pp. 133–163.